Ecosystem Socioeconomic Profile (ESP)

EBS Pacific Cod

Review of draft full ESP, ecosystem and socioeconomic processes, indicator suite and analysis, ecosystem and socioeconomic considerations

NOAA FISHERIES

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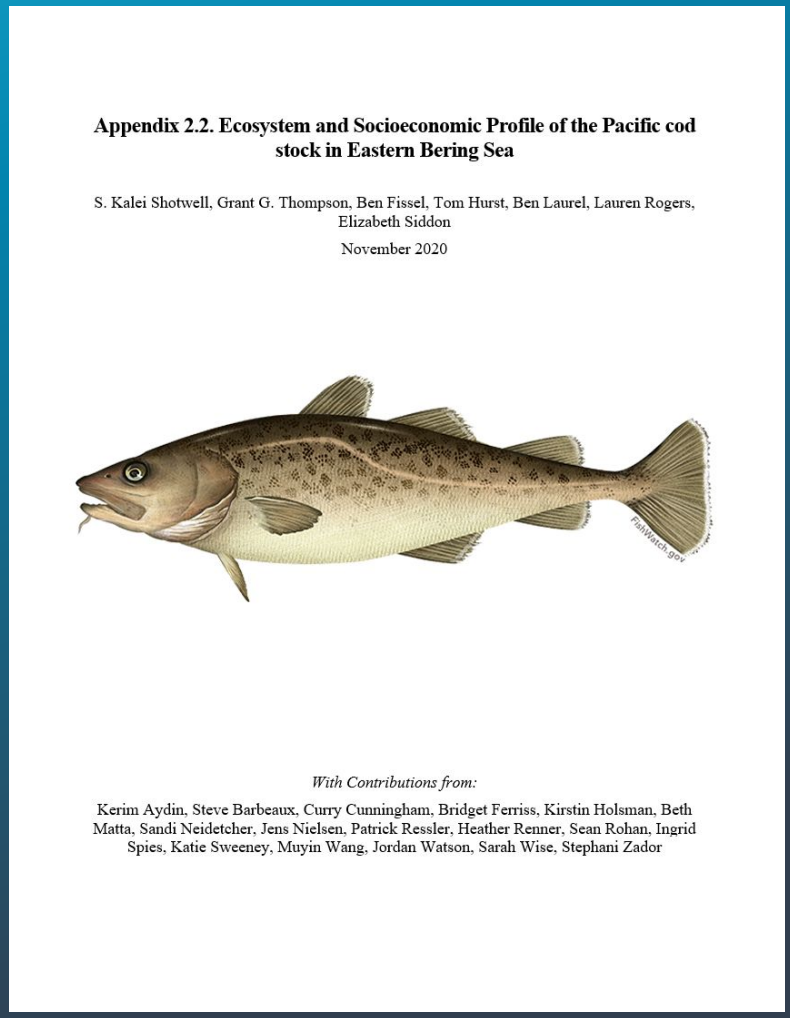
Overview

Appendix in SAFE report

- First Full ESP 2020 (draft)
- Complete full 2021
- 7 editors, 17 contributors
- Recommendations: complete an ESP as time allows, investigate movement into the NBS



Appendix 2.2. Ecosystem and Socioeconomic Profile of the Pacific cod stock in Eastern Bering Sea

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With Contributions from:

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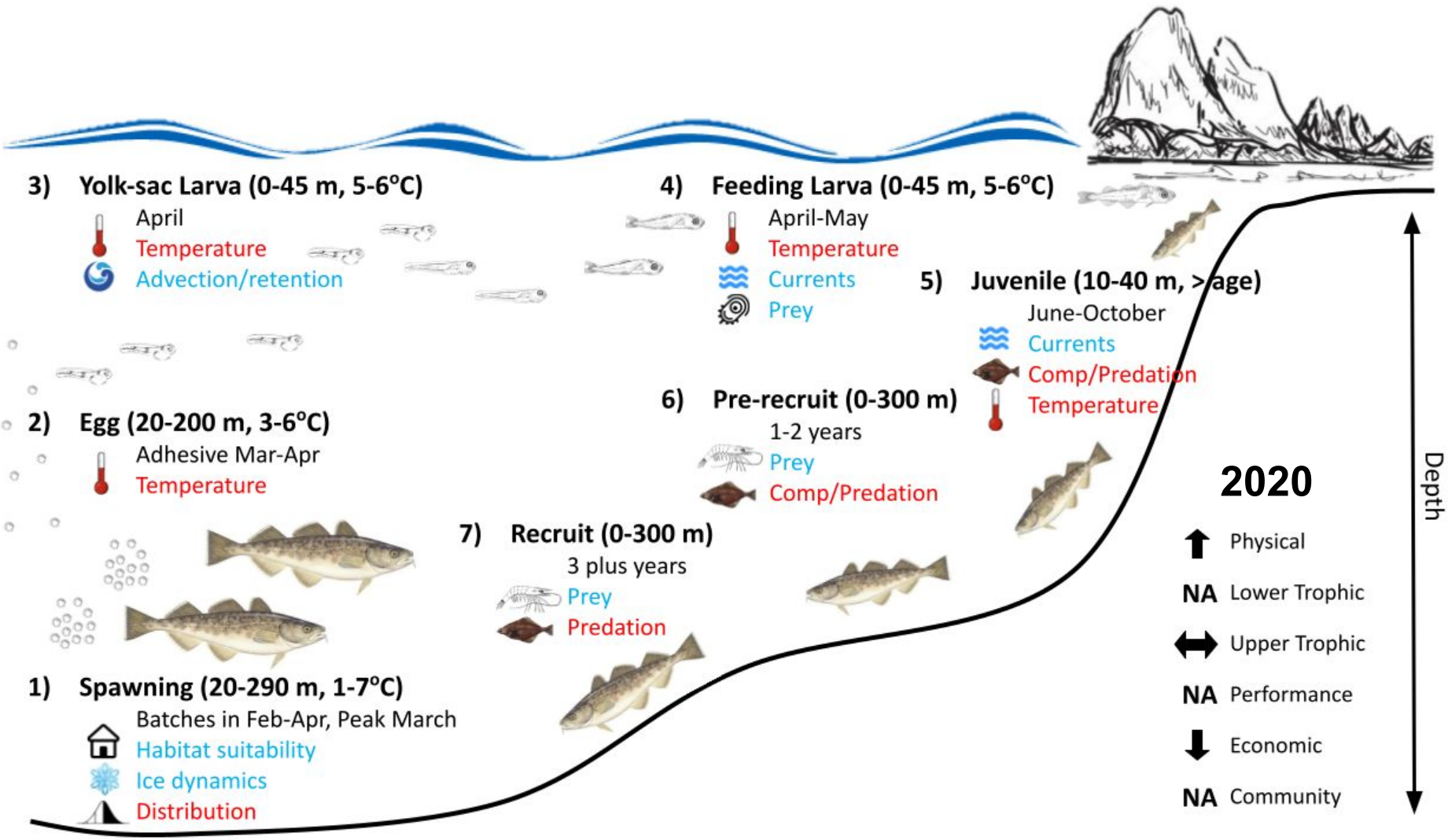
Introduction

- Justification
  - High commercial importance and EL habitat requirements
  - Data-rich stock with high ecosystem target in classification
  - AFSC priority to improve understanding of Pcod dynamics
- Data Sources
  - RACE, REFM, ABL, EcoFOCI, RPA, MML, FMA, PMEL
  - CoastWatch (satellite), BEST-BSIERP, EFH, ISRC (seabirds)
  - Many contributions derived from ESR contributions
  - AKRO, ADF&G, FAO via AKFIN (thank you Jean Lee!!!)

Ecosystem Processes



Ecosystem Processes

Stage	Habitat & Distribution	Phenology	Age, Length, Growth	Energetics	Diet	Predators/Competitors
Recruit	Shore to Shelf (0-500 m), depth varies by age then size(24), sublittoral-bathyal zone, move w/in, between LMEs(24)	Recruit to survey and fishery age-1, length 20-27 cm(24)	Max: 25 yrs, 147♀/134♂ cm L_inf=94 cm, K= 0.2 (24,AFSC)		Opportunistic, small on inverts, large on fish(20, 21, 24, AFSC)	Halibut, Steller sea lions, whales, tufted puffins, fisheries(24); shelf groundfish(24)
Spawning	Shelf (40-290 m)(13-16,24), semi-demersal in shelf areas(13,15,16), seasonal migrations variable duration(26)	Winter-spring, peak mid-March, 13 wks (1,20,25)	1st mature: 2 yr, 26♀/36♂cm, 50%: 4-5yr, 45-65cm (24,AFSC)	Oviparous, high fecundity (250-2220· 10^3) eggs (13,15), range 4-6 °C(14,16)	Opportunistic (20,21)	Halibut, Steller sea lions, whales, tufted puffins, fisheries(24); shelf groundfish(24)
Egg	Shelf (20-200 m), demersal, adhesive eggs(13,15-17,24)	Incubation is ~20 days, 6 wks(14,22)	Egg size: 0.98-1.08 mm (Laurel et al 2008)	Optimal incubation 3-6°C, 13-23 ppt, 2-3ppm dO_2 (LR, 2020)	Yolk is dense and homogenous (AFSC)	
Yolk-sac Larvae	Epipelagic, nearshore shelf, coastal, upper 45 m, semi-demersal at hatching(13-15,18,24)	Spring, peak end April, 14 wks(22)	3-4.5 mm NL at hatch (13-15,24)	1-2 weeks before onset of feeding	Endogenous	Share larval period with pollock(13)
Feeding Larvae	Epipelagic, nearshore shelf(13-15,24), 0-45 m(24)	Late spring(22)	25-35 mm SL at transformation (3,13-15,24)	1-2 weeks before onset of feeding	Copepod eggs, nauplii, and early copepodite stages (Strasburger et al. 2014)	Share larval period with pollock(13)
Juvenile	Nearshore (2-110 m), 15-30 m peak density, inside bays, coastal, mixed, structural complexity (1-6,11,21)	Nearshore settlement in June, deeper water migrations in October(3,13-15)	YOY: 35-110 mm FL(2), age 1+: 130-480 mm FL(1,3,4,6,10); growth sensitive to temp	Energy density ↑ with length, lower in pelagic stage,	Copepods, mysids, amphipods(2), small fish(10), crabs(19-21)	Pollock, halibut, arrowtooth flounder(19,20); macroalgae, eelgrass, structural inverts, king crab, skate egg case, juvenile pollock (1-5,7-9)
Pre-Recruit	Nearshore, shelf (10-216 m)(4), inside bays, coastal, mixed, mud, sand, gravel, rock pebble(1,2,4,6)	Age-2 may congregate more than age-1(25)	Begin to mature age 2-3, 480-490 mm FL (15)	Energy density and condition lower than in pelagic stage	Opportunistic, benthic invert, pollock, small fish, crabs(19-21)	Pacific cod, halibut, salmon, fur seal, sea lion, porpoise, whales, puffin(24); macroalgae, macroinvertebrate, king crab, skate egg case(4-5,7-9)

Ecosystem Processes

Stage	Processes Affecting Survival	Relationship to EBS Pacific cod
Recruit	1. Competition 2. Predation 3. Temperature	Increases in main predator of Pacific cod would be negative but minor predators may indicate Pacific cod biomass increase. Increases in overall prey biomass would be positive for Pacific cod but generalists.
Spawning	1. Ice Dynamics 2. Spawning Habitat Suitability 3. Distribution	Temperatures outside the 3-6 C range contribute to poor hatching success and may impact physiological and behavioral aspects of spawning. Spring bottom temperatures outside this range are linked to observed pre-recruits and recruitment estimates (Laurel and Rogers 2020)
Egg	1. Temperature	Eggs are highly stenothermic (Laurel and Rogers 2020)
Yolk-sac Larvae	1. Temperature 2. Timing of spring bloom 3. Onshore shelf transport	Increases in temperature would increase metabolic rate and may result in rapid yolk-sac absorption that may lead to mismatch with prey. Current direction to preferred habitat would be positive for Pacific cod.
Feeding Larvae	1. Temperature 2. Prey availability 3. Onshore shelf transport	Increases in temperature would increase metabolic rate and may result in poor condition if feeding conditions are not optimal. Onshore transport to nursery habitat would be positive for Pacific cod while predation increases would be negative.
Juvenile	1. Competition 2. Predation 3. Temperature	Evidence of density-dependent growth in coastal nurseries (Laurel et al., 2016) would suggest that increases in competitors or predators would be negative for Pacific cod condition and therefore survival. Temperature increases may amplify risk of food availability and energy allocation (Laurel et al. 2017)
Pre-Recruit	1. Competition 2. Predation 3. Temperature	Evidence of density-dependent growth in coastal nurseries (Laurel et al., 2016) would suggest that increases in competitors or predators would be negative for Pacific cod condition and therefore survival. Temperature increases may amplify risk of food availability and energy allocation (Laurel et al. 2017)

Socioeconomic Processes

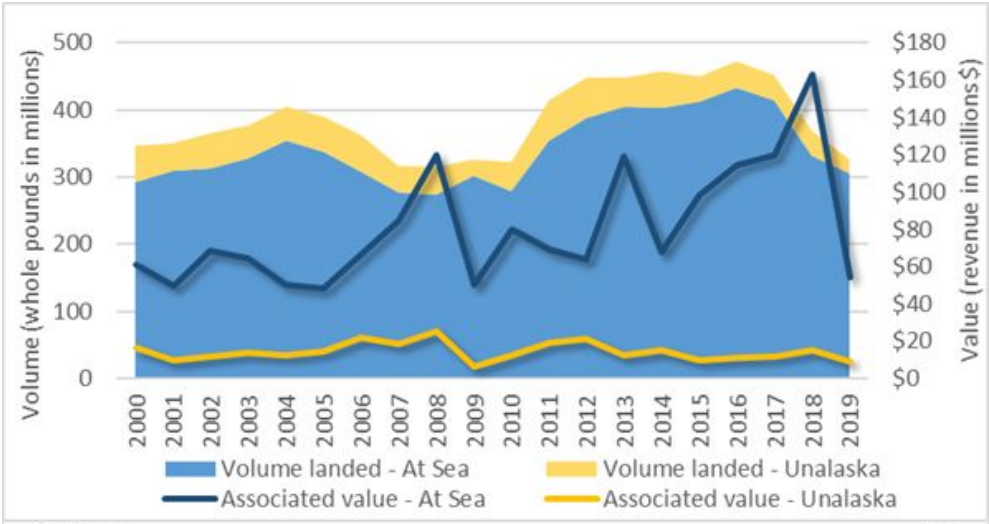
- Economic Performance
  - Paired down version of EPR in assessment report
  - Highlight fishery status
    - Recent < value, > price
    - Projection both down
- Tables (national, global)
  - Five year breakdown of various economic metrics

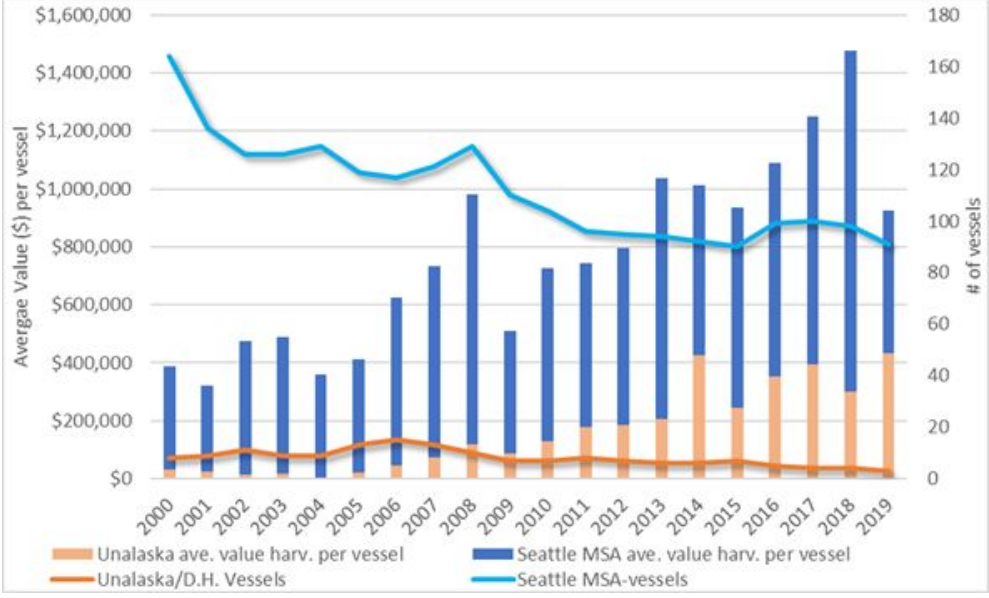
	Avg 10-14	2015	2016	2017	2018	2019
Total catch K mt	228.52	242.1	260.9	253	220.3	197.9
Retained catch K mt	224.1	239.0	257.7	250.1	218.0	195.8
Vessels #	168.4	150	162	173	193	196
CP H&L share of BSAI catch	51%	54%	49%	50%	46%	45%
CP trawl share of BSAI catch	16%	15%	14%	13%	14%	13%
Shoreside retained catch K mt	67.7	68.4	86.0	88.0	82.5	77.5
Shoreside catcher vessels #	116.4	101	110	128	144	149
CV pot gear share of BSAI catch	12%	13%	15%	17%	19%	22%
CV trawl share of BSAI catch	18%	16%	18%	18%	18%	17%
Shoreside ex-vessel value M $	$38.2	$34.1	$44.6	$54.1	$65.1	$62.3
Shoreside ex-vessel price lb $	$0.278	$0.248	$0.264	$0.316	$0.399	$0.418
Shoreside fixed gear ex-vessel price premium	$0.03	$0.06	$0.04	$0.05	$0.06	$0.11

		Avg 10-14	2015	2016	2017	2018	2019
All products	volume K mt	111.82	120.47	126.40	119.54	107.41	94.97
All products	Value M $	$ 330.7	$ 365.0	$ 388.3	$ 434.7	$ 458.8	$ 346.5
All products	price lb $	$ 1.34	$ 1.37	$ 1.39	$ 1.65	$ 1.94	$ 1.65
Fillets	volume K mt	7.23	6.28	10.03	10.01	10.36	8.02
Fillets	value share	14%	10%	19%	19%	21%	20%
Fillets	price lb $	$ 2.86	$ 2.67	$ 3.37	$ 3.70	$ 4.12	$ 3.92
Head & Gut	volume K mt	91.55	100.82	98.68	92.38	79.04	70.25
Head & Gut	value share	79%	83%	72%	74%	71%	72%
Head & Gut	price lb $	$ 1.30	$ 1.36	$ 1.29	$ 1.57	$ 1.86	$ 1.60
At-sea	value share	72%	76%	69%	70%	64%	67%
At-sea	price premium ($/lb)	-$0.07	$0.07	-$0.32	-$0.33	-$0.51	-$0.36

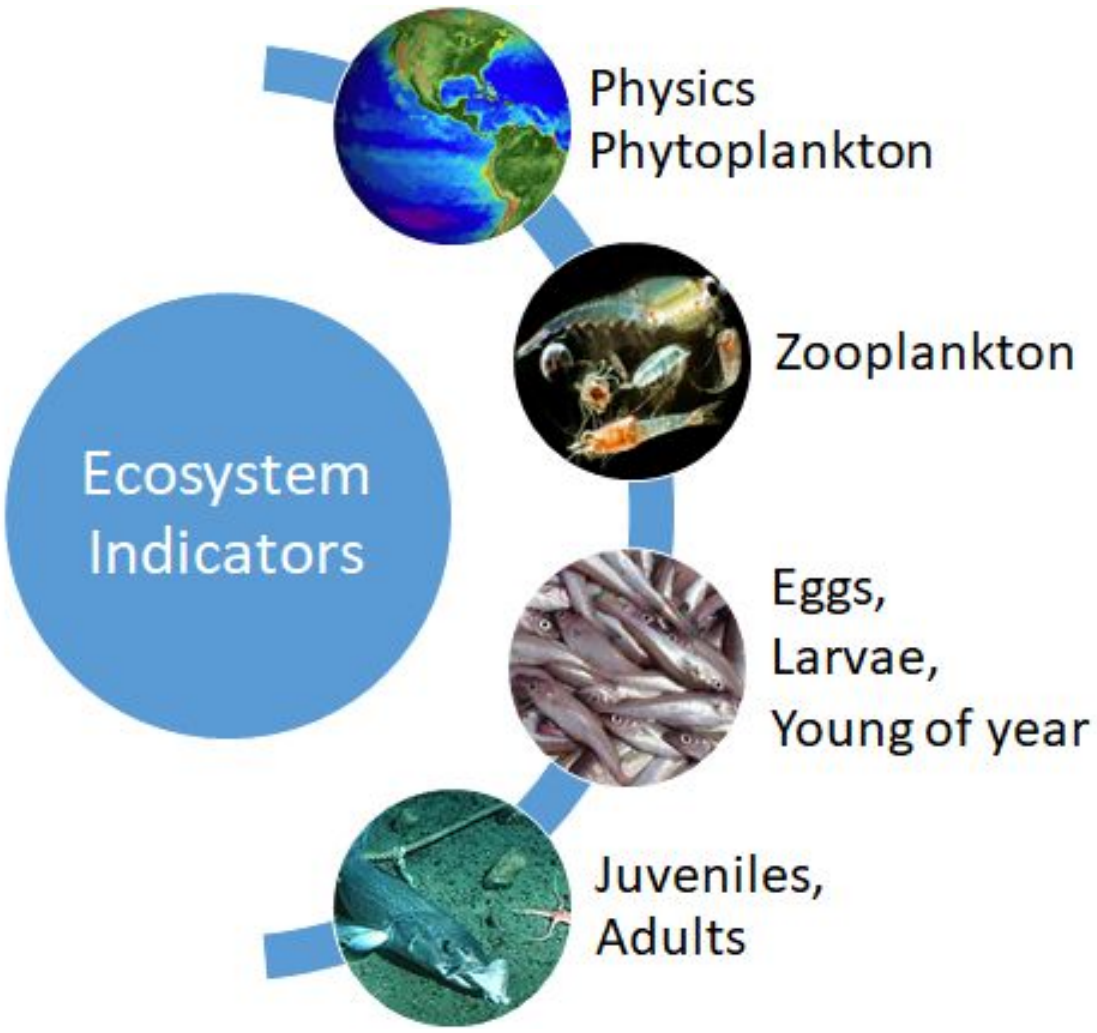
Socioeconomic Processes

- Communities
  - At sea processing accounts for 73% of landed volume
  - Seattle accounts for 63% of harvest value
  - Moderate/high engagement for Unalaska/Dutch
- Engagement metrics
  - Regional quotient for processing and harvesting





Current Ecosystem Indicators



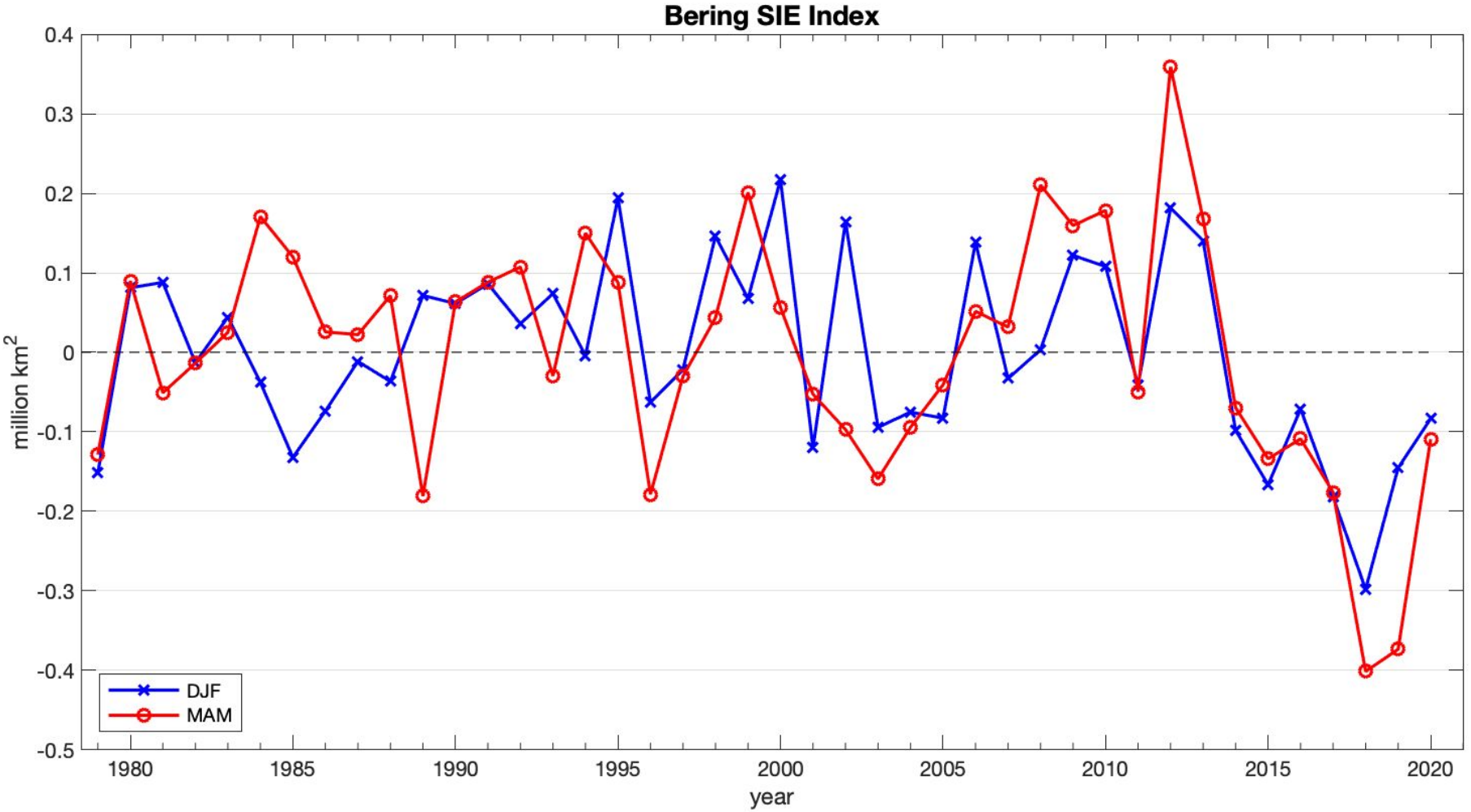
1. North Pacific Index
2. Sea ice extent (DJF)
3. Sea ice advance (MAM)
4. Sea surface temperature (satellite)
5. Summer bottom temperature (ROMS)
6. Spring bloom peak timing (satellite)
7. Euphausiids (acoustic backscatter)
8. Juvenile condition, bottom trawl survey
9. Adult condition, bottom trawl survey
10. Center of gravity, eastings (VAST)
11. Center of gravity, northings (VAST)
12. Area occupied (VAST)
13. Predator biomass, arrowtooth

Current Socioeconomic Indicators

1. Ex-vessel value
2. Ex-vessel price per pound
3. Revenue per unit effort
4. Processing regional quotient for Unalaska/Dutch Harbor
5. Harvesting regional quotient for Unalaska/Dutch Harbor

Physics - Sea Ice

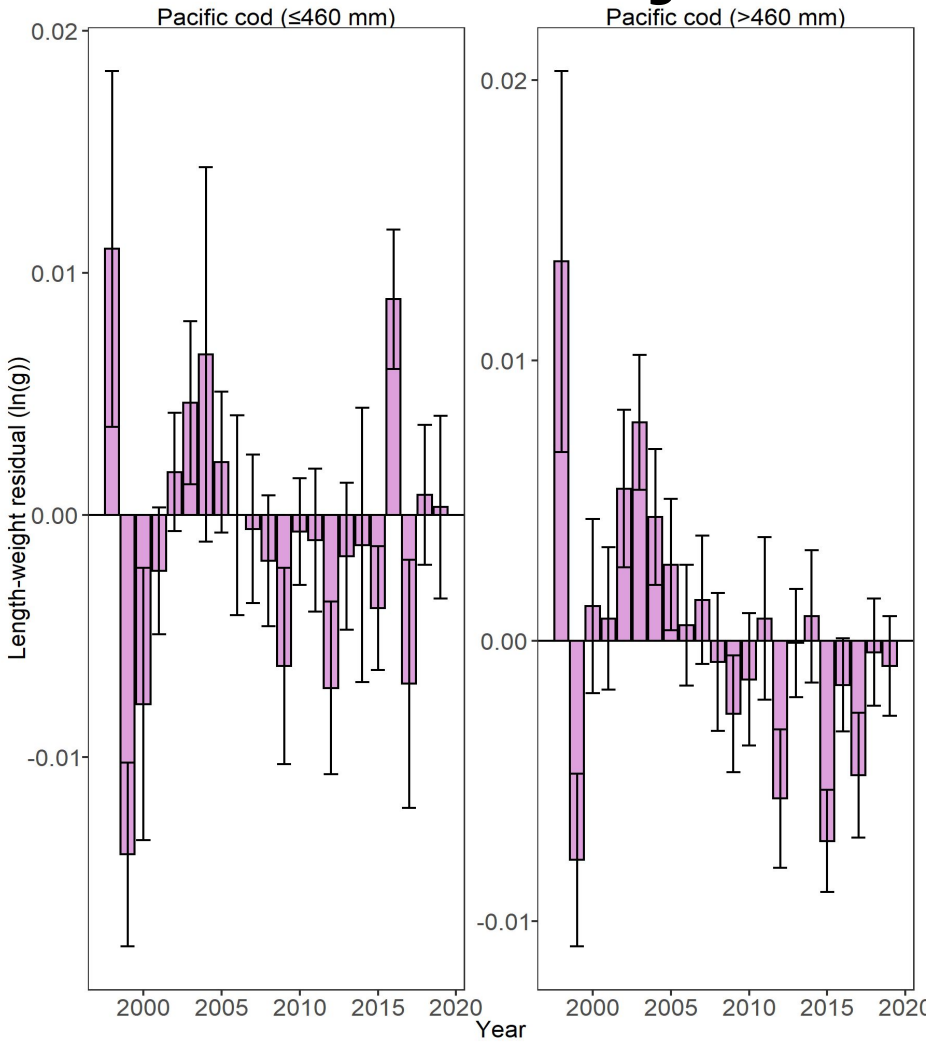
Courtesy Wang



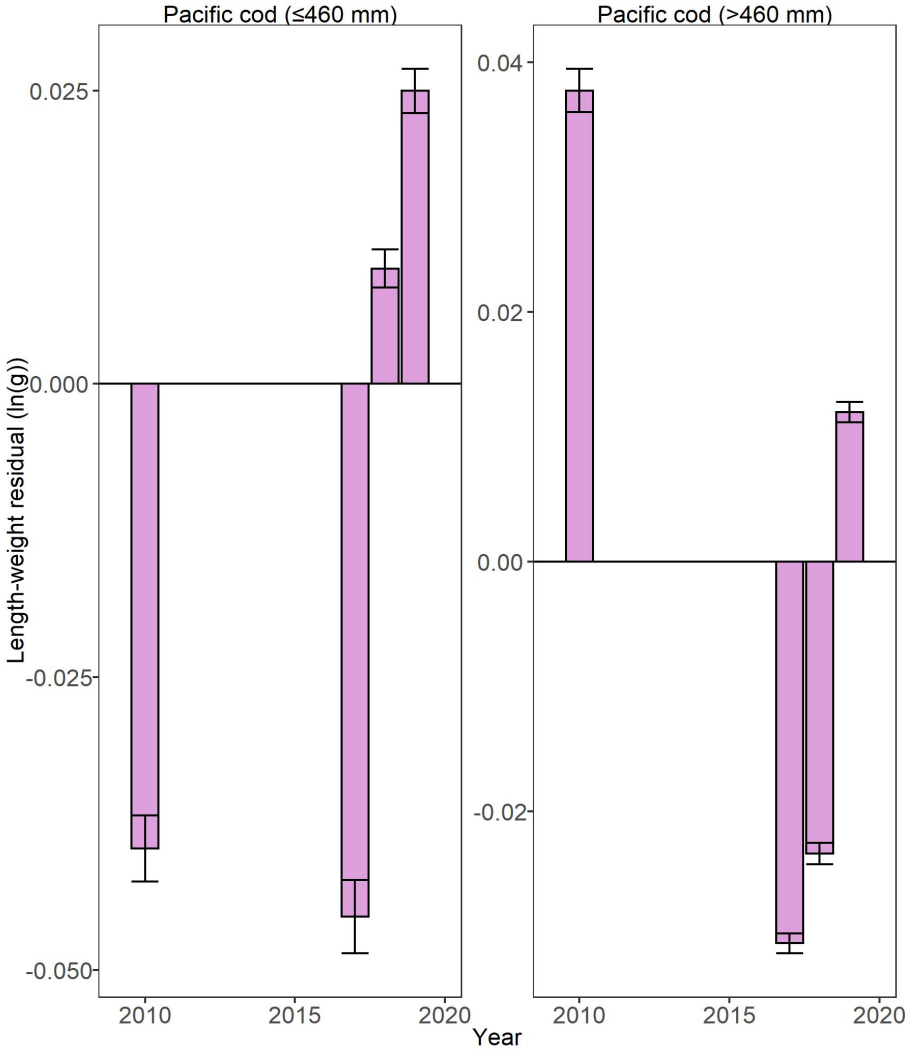
BTS Condition

Courtesy Rohan, Laman

Southeastern Bering Sea

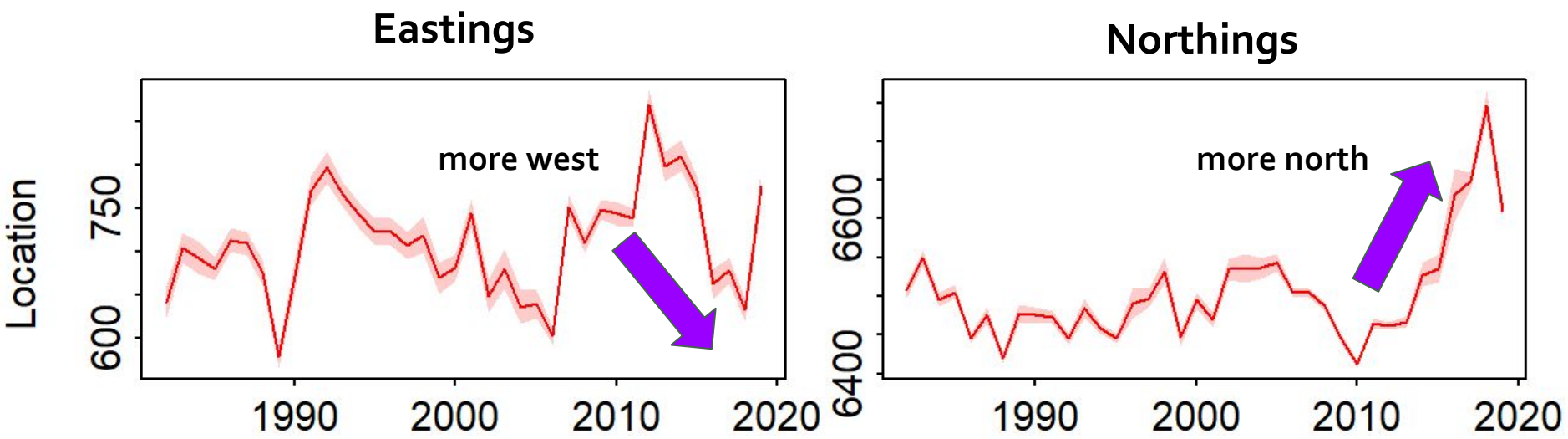


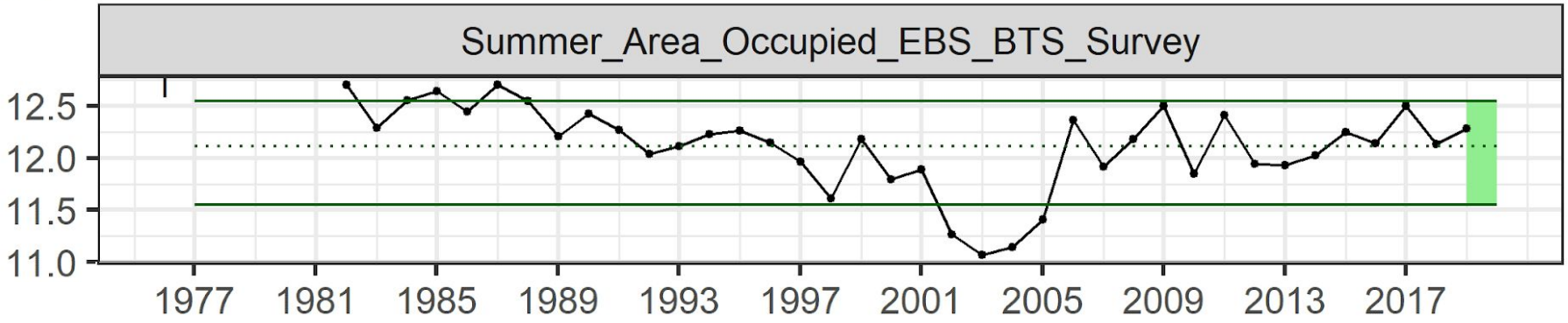
Northern Bering Sea



VAST-ness

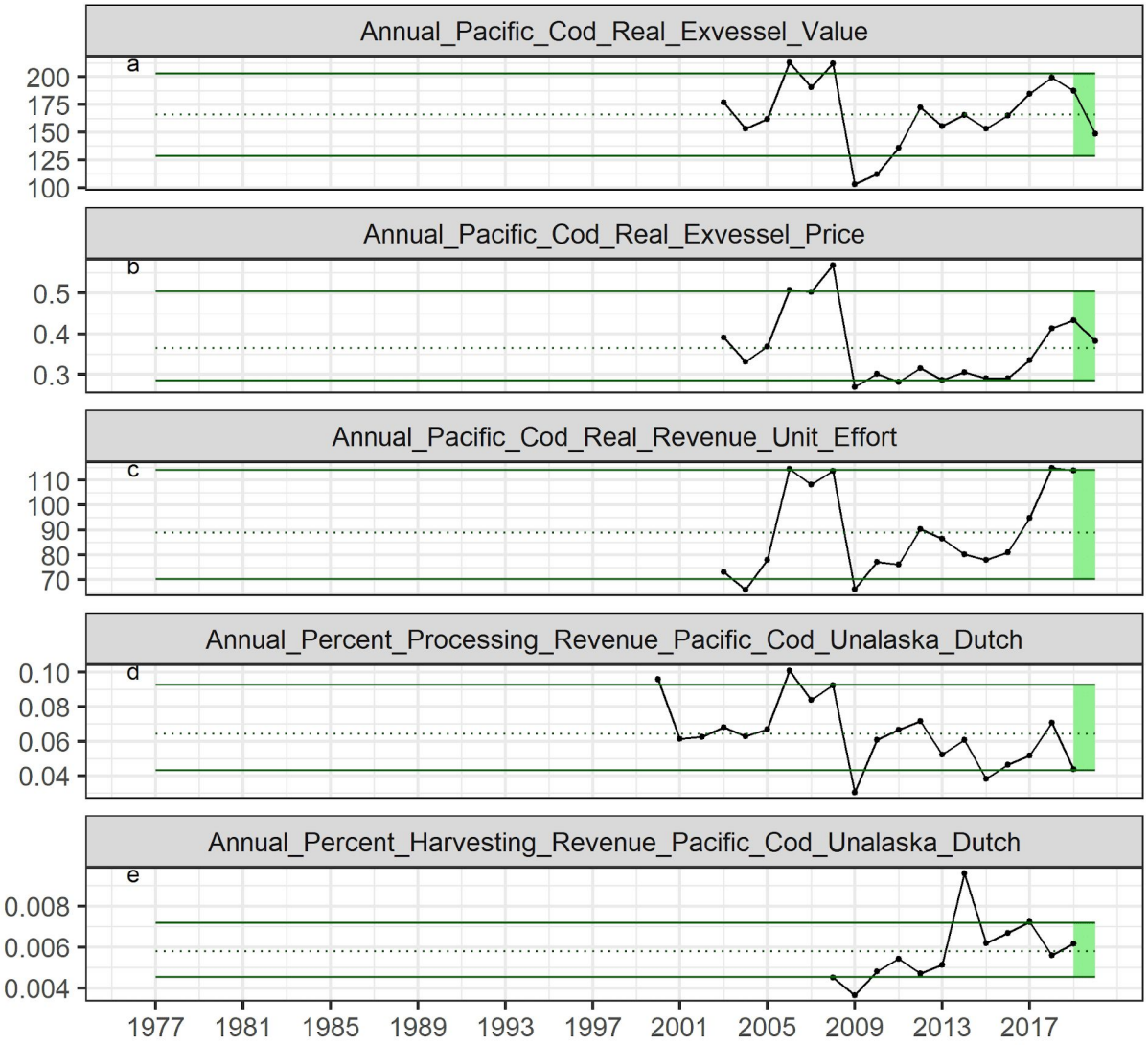
Courtesy Thorson





Socioeconomics

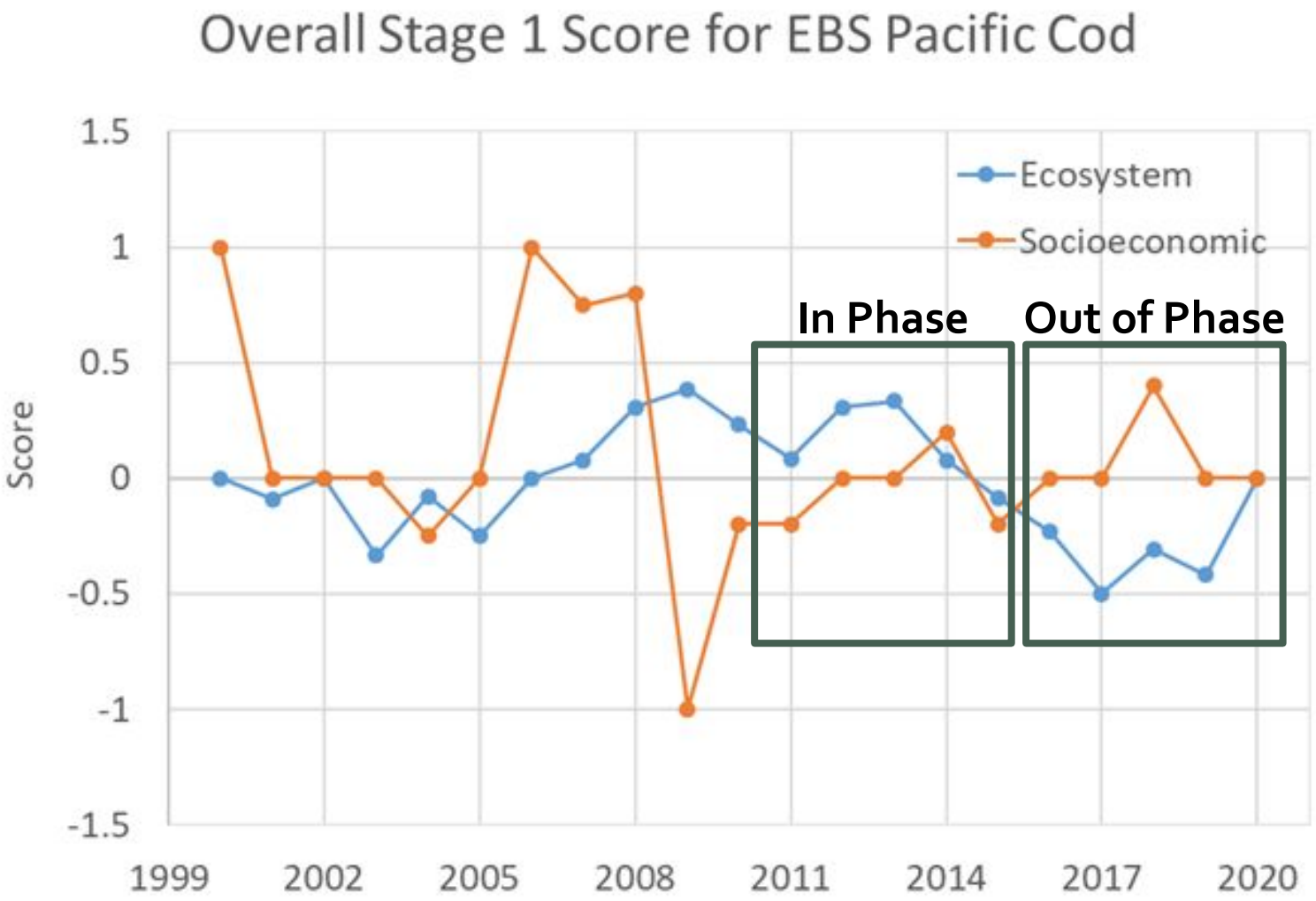
Courtesy Fissel, Wise



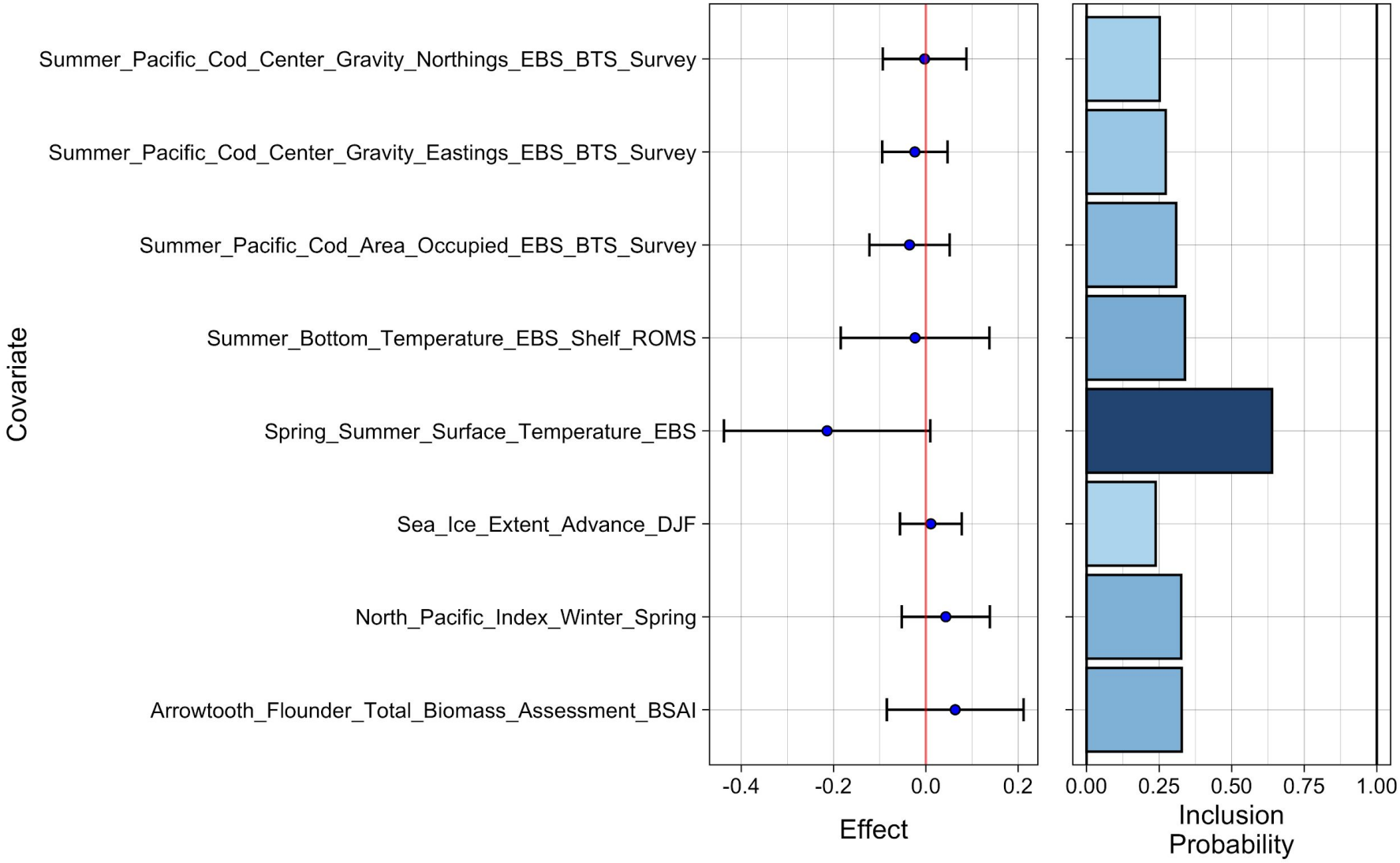
Indicator Analysis

- 1st Stage Simple Score
  - Requested by SSC for ESPs in February 2020
  - Based on value compared to 1 sd from mean of series
  - Use +1, -1, 0 to count G/P/S then / by total indicators
  - Evaluate by category and overall total
- Historical Score
  - Provide a table of scores for last 20 years by category
  - Provide graphic of ecosystem and socioeconomic total

Indicator Analysis - Stage 1 Score



Indicator Analysis - Stage 2 BAS



ESP Considerations

- Ecosystem Summary
  - Hatch success temp dependent, impacts spawning habitat
  - Population center moved northwest with sea ice retreat
  - Condition moderate to below avg in SEBS, ⬆️ in NBS
  - Physical ⬆️ ⬆️, lower and upper stable, out of phase w/ SE
- Socioeconomic Summary
  - Ex-vessel value, price/pound, revenue/effort ⬆️ 2015-19
  - Unalaska/Dutch Harbor processing RQ ⬇️, harvesting ⬆️

Next Steps

- Workshops
  - Advice Workshop, spring 2021
  - Create technical memorandums, guidelines for indicator analysis, rapid template
- Data and Coordination
  - Continue developing dashboard on AKFIN
  - Standard suite of indicators (e.g., follow ECSA?)
  - Automate full, partial reporting templates
- ESP Manuscripts, overview and workshop


Questions?